# International Space Weather Action Teams

PSW

***Space weather is a global threat.***
***Understanding and predicting space weather is a global challenge.***

## Call for Actions:

## Unite
## Join I-SWAT

*GLOBAL COMMUNITY* HUB

• ASSESSMENT • IMPROVEMENT • DEVELOPMENT • DISSEMINATION •

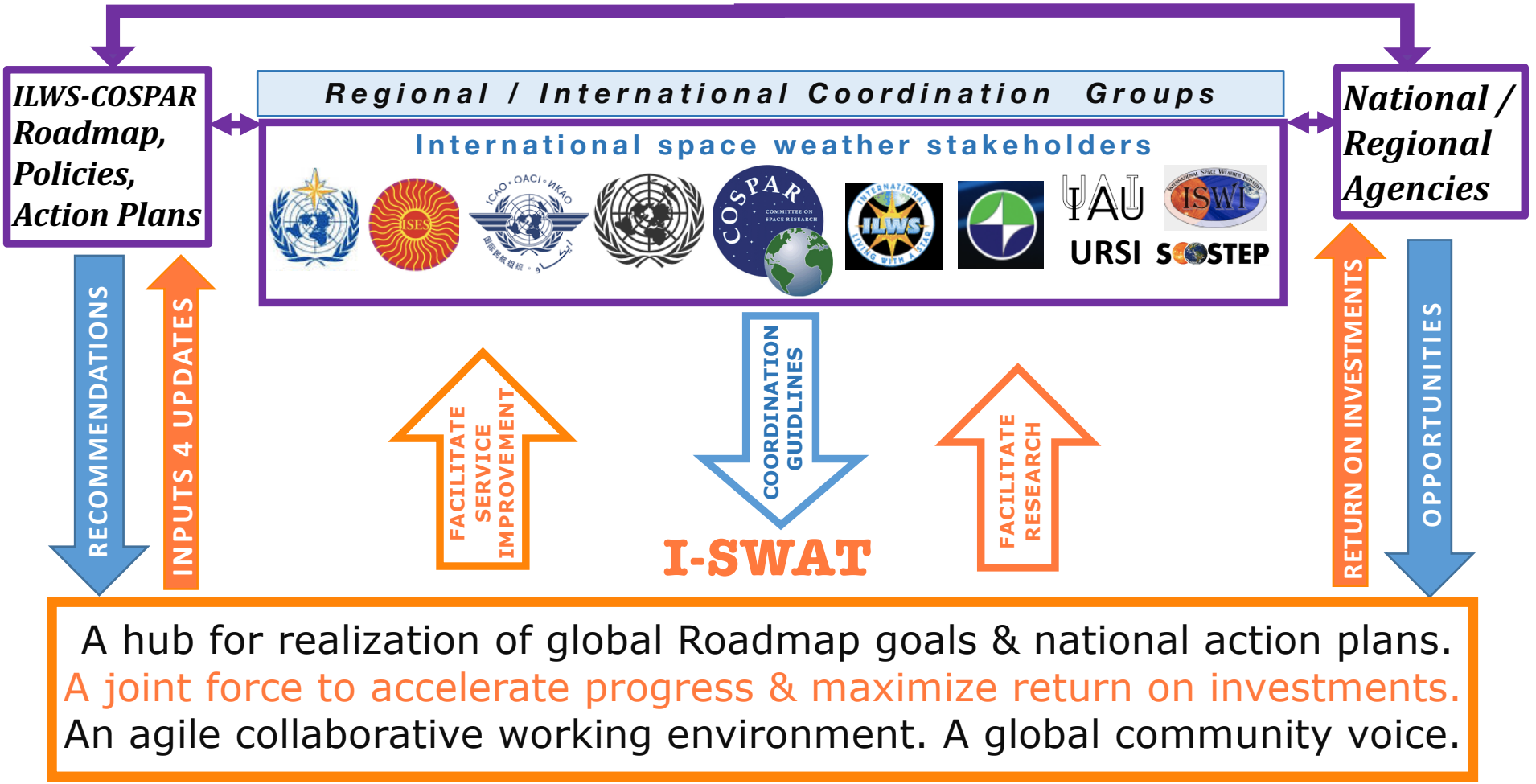
*GLOBAL COMMUNITY* VOICE

# I-SWAT Goals

- Provide a **global hub** for space weather community efforts toward the **realization** of ILWS-COSPAR Roadmap goals.
- Create an inclusive, information-sharing, agile working environment that encourage **active participation**, emergence of new leads and innovative ideas.
- Facilitate collaborative space weather **research**, model and tool **development**, testing and **evaluation**, and efficient **utilization of observational data.**
- Enable **rapid incorporation** of latest **research** findings into space weather forecasting & analysis applications, aiming to **address user needs** and **facilitate improvement of operational services**.
- Provide a channel for a **global community voice** and a **bottom-up** push for improvements and innovation.
- Engage community in strategic planning (**Roadmap updates**) based on latest scientific advances and evolving user requirements.

***GLOBAL*** **HUB** • **EXPERTISE** • **NOVELTY** • **EFFICIENCY** • **COLLABORATIVE ENVIRONMENT** • **AGILITY** • ***GLOBAL*** **VOICE**

# A Global Space Weather Community Initiative, a Bottom-up Voice and an Action Hub.




A hub for realization of global Roadmap goals & national action plans.
A joint force to accelerate progress & maximize return on investments.
An agile collaborative working environment. A global community voice.

# I-SWAT is a Hub Facilitating Multi-Way Connections Between Key Elements of Space Weather Ecosystem

*I-SWAT brings together domain experts, model & application developers, space weather service providers (e.g., ISES), and* expert-users *of space weather information (e.g., mission specialists, infrastructure engineers).*


**RESEARCH** | **A HUB 4 TRANSITION 2 OPERATIONS** | **OPERATIONS**

## ASSESSMENT

Assessment of observations and model output quality, prediction accuracy and reliability. Tracking progress against established metrics and benchmarks. Providing feedback to model developers. Prototyping of forecasting & analysis techniques for potential transition to operations (i.e., operational **SERVICES**).

## DISSEMINATION

**Development** of forecasting and analysis tools and global networks of applications and archives for interactive assess to models, simulations, observational data, impact information.

Incorporation of latest advances in **UNDERSTANDING, OBSERVATIONS & MODELING** into space weather forecasting & analysis applications.

# Sun-to-Impact I-SWAT Clusters (by Domain / Phenomena)

| *Space weather origins at the Sun - S* | *Propagation of transient through evolving ambient Heliosphere - H* | *Coupled magnetosphere ionosphere-atmosphere (geospace - G) system response to solar drivers* | ***Impacts*** |
|---|---|---|---|
| ***Solar output Input to heliosphere and geospace*** | ***Input to geospace*** | | |
| **S1.** Long-term solar variability. Prediction of solar cycles. | **H1.** Time of CME arrival. Plasma parameters and magnetic field structure within CME approaching geospace. | **G1.** Geomagnetic environment. | ***Electric power systems, GICs*** |
| **S2.** Solar magnetic field & heating. Ambient magnetized solar wind and spectral irradiance. | | **G2.** Ionosphere / atmosphere variability. | ***Positioning / Navigation / Communication*** |
| **S3.** Solar eruptions: CMEs, flares, enhanced electromagnetic emissions and high energy particle fluxes. | **H2.** SEP in heliosphere. | **G3.** Near-Earth radiation & plasma environment. | ***(Aero)space assets*** - *Satellite / debries drag* - *Satellite / aviation funcitions,* - *Astronauts health* |

# I-SWAT Clusters Linked to Roadmap Pathways, Timing of Space Weather Information & Character of Requirements

| Timing of Space Weather Information | Character of Requirements | Roadmap Pathways | I-SWAT Clusters |
|---|---|---|---|
| **Climatology & Extremes:** past and future. | Risk assessment.<br>Mission planning. Design specifications. | 1 | S to H1 to G:G1-G2 |
| | | 2 | S to H to G:G3 |
| **Archives** of past conditions & historic space weather events. | Historic-events-based model validation.<br>Post-facto analysis of space weather impact on (aero)space systems. | 1 | S2-S3 to H1 to G:G1-G2 |
| | | 2 | S2-S3 to H to G:G3 |
| **From L1 to geospace.**<br>Real-time geospace **data assimilation.** | Specifications of current conditions<br>Situational awareness<br>Short-term forecasts (30 – 60 min) | 1 | G:G1-G2 |
| | | 2 | G:G3 |
| **Post-eruption**<br>From Sun to L1 to geospace | Mid-range forecasts (>12 hours) | 1 | S2-S3 to H1 to G:G1-G2 |
| | | 3 | S2-S3 to H to G:G3 |
| **Pre-flare** | Short-term, mid-range, all-clear forecasts | 3 | S2-S3 to G:G2-G3 |

## Cross-Domain and Special I-SWAT

- **Coordinated information dissemination**:
  - meta-data standards,
  - a global networks of inter-connected applications and interactive archives.
- **Optimized data utilization**:
  - innovative approaches for data mining, data incorporation, data assimilation, model-data comparison, quantification and reduction of uncertainties.

- **Hands-on education** opportunities for young scientists and developing research groups.
- **Space Weather in solar system and beyond (other planets & exoplanets).**

# Examples of I-SWAT Tasks

- **REVIEW**
  - Review of  recommendations and guidelines.
  - Inventory of available resources and on-going efforts.
- **ASSESSMENT**
  - Evaluation of data and model output quality, prediction accuracy and reliability, and application usability. Tracking progress against established metrics.
  - Assessment and quantification of societal vulnerabilities.
  - Prototyping for future operational capabilities (e.g., community ensemble forecasting, collaborative distributed modeling, coordinated observations).
  - Identification of opportunities for improvements.
- **DISSEMINATION, DEVELOPMENT & IMPROVEMENT**
  - **Development** of forecasting and analysis tools and global networks of applications and archives for interactive assess to models, simulations, observational data, impact information.
  - **Incorporation** of latest **research** findings into space weather forecasting & analysis applications.
  - Refinement of indices and activity scales.
  - Improvement of archives for anomaly analysis. Improvement of data utilization.
  - Analyses of climatology and past and future extremes.
- **COORDINATED FEEDBACK, UPDATES, INPUTS**
  - E.g., on policies, mission planning, periodic COSPAR ILWS Roadmap updates..

# I-SWAT Core Principles and Rules of the Road (under construction)

- Dynamic membership to encourage active participation and emergence of new leads and innovative ideas.
- Self-organising, non-beuracratic structure of I-SWAT teams.
- Line-up with available funding opportunities.

- Level of participation and responsibilities (TBD)
  - **Moderators / Coordinators** of I-SWAT clusters
  - **Team leads (**leaders are not appointed, they are emerged).
  - **Active participants** (open to all motivated groups and individuals committed to active participation)
  - **Followers** (after about 6 months of no-activity)

# Opportunities for Hands-on Education

- Build upon UN / ISWI educational activities and I-REDI (International Research, Education and Development Initiative) initiated by the CCMC.
- Engage students in activities that are pushing the frontiers of research, development, and experimental operations.
- Create an environment for students from different countries and different career goals to work together for the benefit of society, and strengthen international collaborations.
- Promote space environment awareness as an important component of the new millennium core education.
- Address a growing need for the next generation professionals to understand the fundamentals of the Sun-Earth system, and the impacts of space weather on humans and technologies.
- **Encourage motivated graduate students to join I-SWAT projects as active participants and possibly co-leads**
- Initiate **Space Weather World Relay** that will engage students from multiple *time zones* around the globe in innovative and collaborative space weather monitoring, analysis, and forecasting (possibly with UN COPUOS, COSPAR Capacity Building ).